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The effects of diet form and feeder design on the growth performance and carcass characteristics of growing-finishing pigs

Abstract

A total of 1,290 growing pigs (PIC 1050 x 337, initially 103.1 lb) were used in a 91-d study to evaluate the effects of diet form (meal vs. pellet) and feeder design (conventional dry vs wet-dry) on finisher pig performance. The treatments were arranged in a 2 x 2 factorial with 11 replications per treatment and 25 to 27 pigs per pen. Half of the pens were equipped with a 5-hole conventional dry feeder while the other half had a double-sided wet-dry feeder. All pigs were fed a corn-soybean meal-based diet containing 45 to 65% by-products in 4 phases. The only difference among treatments was diet form (meal vs. pellet). Pen weights and feed disappearance were measured on d 0, 16, 21, 43, 57, 71, and 91. Pictures of feeder pans were taken during Phase 4 and then evaluated by a panel of 4 for percentage of pan coverage. From d 0 to 91, no diet form x feeder design interactions were observed for ADG. Pigs fed pelleted diets had a tendency for improved ($P < 0.07$) ADG compared to those given meal diets. In addition, pigs fed with wet-dry feeders had improved ($P < 0.01$) ADG compared to those with conventional dry feeders. A diet form x feeder design interaction was observed ($P < 0.04$) for ADFI. When using a wet-dry feeder, pigs given meal diets had similar ADFI as those fed pelleted diets. However, when using dry feeders, pigs given pelleted diets had a much greater ADFI than pigs fed meal diets. In addition, a diet form x feeder design interaction was observed for F/G. Pigs fed both meal and pelleted diets via wet-dry feeders had similar F/G, but pigs fed pelleted diets in a conventional dry feeder had poorer F/G compared to pigs given meal diets in a conventional dry feeder. The pellets used during this experiment had average percentage fines of 35.1 ± 19% and an average pellet durability index (PDI) of 75.8 ± 8.4. We attribute the interactions to the poor pellet quality, leading to more feed wastage from the dry feeders. These results suggest that pellet quality is important to decrease feed wastage and sorting by the pigs and to optimize growth performance.; Swine Day, Manhattan, KS, November 18, 2010

Keywords

Swine Day, 2010; Kansas Agricultural Experiment Station contribution; no. 11-016-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1038; Swine; Feeder; Feed processing; Pelleting

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The Effects of Diet Form and Feeder Design on the Growth Performance and Carcass Characteristics of Growing-finishing Pigs[1]

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Summary
A total of 1,290 growing pigs (PIC 1050 × 337, initially 103.1 lb) were used in a 91-d study to evaluate the effects of diet form (meal vs. pellet) and feeder design (conventional dry vs wet-dry) on finisher pig performance. The treatments were arranged in a 2 × 2 factorial with 11 replications per treatment and 25 to 27 pigs per pen. Half of the pens were equipped with a 5-hole conventional dry feeder while the other half had a double-sided wet-dry feeder. All pigs were fed a corn-soybean meal-based diet containing 45 to 65% by-products in 4 phases. The only difference among treatments was diet form (meal vs. pellet). Pen weights and feed disappearance were measured on d 0, 16, 21, 43, 57, 71, and 91. Pictures of feeder pans were taken during Phase 4 and then evaluated by a panel of 4 for percentage of pan coverage. From d 0 to 91, no diet form × feeder design interactions were observed for ADG. Pigs fed pelleted diets had a tendency for improved ($P < 0.07$) ADG compared to those given meal diets. In addition, pigs fed with wet-dry feeders had improved ($P < 0.01$) ADG compared to those with conventional dry feeders. A diet form × feeder design interaction was observed ($P < 0.04$) for ADFI. When using a wet-dry feeder, pigs given meal diets had similar ADFI as those fed pelleted diets. However, when using dry feeders, pigs given pelleted diets had a much greater ADFI than pigs fed meal diets. In addition, a diet form × feeder design interaction was observed for F/G. Pigs fed both meal and pelleted diets via wet-dry feeders had similar F/G, but pigs fed pelleted diets in a conventional dry feeder had poorer F/G compared to pigs given meal diets in a conventional dry feeder. The pellets used during this experiment had average percentage fines of 35.1 ± 19% and an average pellet durability index (PDI) of 75.8 ± 8.4. We attribute the interactions to the poor pellet quality, leading to more feed wastage from the dry feeders. These results suggest that pellet quality is important to decrease feed wastage and sorting by the pigs and to optimize growth performance.

Key words: feeder, feed processing, pelleting

Introduction
With tightening profit margins, producers are looking for ways to improve feed efficiency and optimize gain without increasing diet costs. Recent research (Bergstrom et al., 2008[3]) has shown that pigs fed with wet-dry feeders have increased feed intake and gain. In addition, research has shown ADG typically increases 4 to 6% when pigs are

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[3] Bergstrom et al., Swine Day 2008, Report of Progress 1001, pp 196-203.

presented pelleted diets via a conventional dry feeder. Previous research done at Kansas State University (Amornthewaphat et al., 2000[4]) has shown that feeding pelleted diets via a wet-dry feeder had little impact on growth performance in finisher pigs. This study, conducted in a university research facility, also utilized diets with no added by-products, which results in a higher quality pellet. However, since feeding diets without by-products is no longer common, it is important to determine whether feeding pelleted diets containing by-products via wet-dry feeders is beneficial. In addition, we wanted to determine whether it is practical to implement pelleted diets into a commercial operation. Therefore, the objective of the study was to evaluate the effects of diet form (meal vs. pellet) and feeder design (conventional dry vs. wet-dry) on finishing pig performance.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted in a commercial research finishing facility in southwestern Minnesota.

A total of 1,290 growing pigs (PIC 1050 × 337, initially 103.1 lb) were used in a 91-d trial. Pens were randomly allotted to treatments based on average initial weight and number of pigs per pen. There were 25 to 27 pigs per pen and 11 pens per treatment. The number of barrows and gilts within each pen was the same across all pens. The treatments were arranged in a 2 × 2 factorial with the main effects of diet form (meal vs. pellets) and feeder design (conventional dry vs. wet-dry). Half of the pens were equipped with a conventional 5-hole dry feeder (STACO, Shafferstown, PA). The other half contained a double-sided, wet-dry feeder that provided both feed and water via a 15-in feeder opening on either side (Crystal Springs, Gro Master, Omaha, NE). All pens contained cup waterers. All the wet-dry feeders were adjusted to setting 14, or 1.00-in. minimum gap width. Conventional dry feeders that contained the meal diets were adjusted to setting 8, or a minimum gap width of 1.00 in. Conventional dry feeders with pelleted diets were adjusted to setting 6, or 0.70-in. minimum gap width, for the duration of the trial.

Pigs were provided ad libitum access to feed and water. A common diet containing 45 to 65% by-products was fed in four dietary phases (Table 1). Diets differed only in form: meal vs. pellet. Average daily gain, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 0, 16, 29, 43, 57, 71, and 91. On d 71, 3 pigs (2 barrows and 1 gilt) from each pen were weighed and then removed for marketing. At the conclusion of the trial, d 91, carcass data were obtained for 939 pigs to determine HCW, percentage yield, backfat depth, loin depth, and fat-free lean index. Pictures of feeder pan coverage were taken during Phase 4 and then scored by a panel of 4 for percentage of pan coverage. Feed samples were taken during each phase and then analyzed for percentage fines and PDI (pellet durability index). Percentage fines were determined using a number 6 screen, while PDI was determined by tumbling 500-g samples of feed for 10 minutes, and then using a number 6 screen to sift off the fines.

[4] Amornthewaphat et al., Swine Day 2000, Report of Progress 858, pp 127-131.

Data were analyzed as a 2 × 2 factorial in a completely randomized design using the PROC MIXED procedure of SAS (SAS Institute, Inc., Cary, NC). Pen was the experimental unit.

Results and Discussion

From d 0 to 91, no diet form × feeder design interactions were observed for ADG. Pigs fed pelleted diets had a tendency for improved ($P < 0.07$) ADG compared to those presented meal diets (Table 2). In addition, pigs with wet-dry feeders had increased ($P < 0.01$) ADG compared to those with conventional dry feeders. A diet form × feeder design interaction was observed ($P < 0.04$) for ADFI. Pigs fed meal diets with a dry feeder had lower feed intake ($P < 0.05$) compared to those fed the other treatments. In addition, we observed a diet form × feeder design interaction for F/G ($P < 0.01$). Pigs fed both meal and pelleted diets via wet-dry feeders had similar F/G, but pigs fed pelleted diets in a conventional dry feeder had poorer F/G than pigs given meal diets in a conventional dry feeder.

An interaction was observed for feeder coverage score, where pigs fed both pelleted and meal diets in wet-dry feeders had similar feeder pan coverage ($P < 0.01$; Figures 1 to 4). The interaction was because pigs presented pelleted diets in conventional dry feeders had substantially more feeder pan coverage compared to pigs fed meal diets in conventional dry feeders. We believe the increased pan coverage in the dry feeders can be attributed to increased sorting of the feed due to poorer quality pellets. The pelleted diets averaged 35.1% fines, with a PDI of 75.8. However, when feed was presented in the wet-dry feeders, pigs were unable to sort the pelleted diets due to the addition of water. This led to similar pan coverage in the wet-dry feeders between the meal and pelleted diets. Additionally, the conventional dry feeder had to be set with a wider opening for pelleted diets than for meal diets to prevent feeder plugging. This was not a problem with the wet/dry shelf feeder. We believe the pan coverage and pellet quality indexes explain why, in this trial, pigs fed the pelleted diets had poorer feed efficiency compared to those fed meal diets in the dry feeders. This is in contrast to other research that suggests that feeding pelleted diets results in improved feed efficiency.

There were no diet × feeder interactions or effects of diet detected for any of the carcass criteria evaluated (Table 3). However, pigs fed with conventional dry feeders had less ($P < 0.01$) backfat depth compared to pigs with the wet-dry feeders. This resulted in pigs fed with dry feeders having higher ($P < 0.01$) percent lean compared to those with wet-dry feeders. This difference was apparent even after adjustment to a common carcass weight. Therefore, similar to previous research findings in these same barns, feeding pigs with conventional dry feeders resulted in leaner carcasses compared to pigs with wet-dry feeders.

Similar to other studies in these barns, the wet-dry feeders improved both ADG and feed intake compared to conventional dry feeders but resulted in pigs with fatter carcasses. As expected, feeding pelleted diets tended to improve ADG. However, with the dry feeders, feeding pelleted diets unexpectedly led to poorer feed efficiency when using conventional dry feeders and no difference between meal and pellet feeding when using wet-dry feeders. We believe the poorer feed efficiency was the result of increased feed wastage. We attribute the increased feed wastage with the dry feeders to increased sorting by the pigs due to poorer quality pellets.

Table 1. Composition of diets, (as-fed basis)[1,2]

Item	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Ingredient, %					
Corn	33.32	22.15	21.11	27.71	28.18
Soybean meal, (46.5% CP)	16.70	12.10	9.05	9.20	13.60
DDGS[3]	45.00	45.00	35.00	30.00	25.00
Bakery meal	---	15.00	30.00	30.00	30.00
Limestone	1.30	1.25	1.07	1.04	0.99
Salt	0.38	0.14	0.20	0.20	0.20
Vitamin premix	0.09	0.09	0.08	0.08	0.08
Liquid lysine, 60%	---	---	0.54	0.54	0.59
Lysine sulfate	0.64	0.65	---	---	---
Threonine	---	---	---	0.01	0.12
Phytase[4]	0.01	0.01	0.01	0.01	0.01
Tylan 40	0.01	0.01	0.01	0.01	---
Paylean[5]	---	---	---	---	0.03
Total	100	100	100	100	100
Calculated analysis[6]					
Standardized ileal digestible amino acids,%					
Lysine	1.06	0.95	0.84	0.84	0.97
Isoleucine:lysine	76	78	76	73	68
Methionine:lysine	34	35	35	34	30
Met & Cys:lysine	68	72	72	69	61
Threonine:lysine	66	67	65	64	70
Tryptophan:lysine	19.7	19.9	19.3	18.6	17.8
Total lysine, %	1.19	1.07	0.94	0.94	1.08
CP, %	23.5	22.0	19.3	18.6	19.5
ME kcal/lb	1,453	1,499	1,532	1,510	1,523
Ca, %	0.65	0.63	0.55	0.53	0.52
P, %	0.56	0.53	0.47	0.45	0.44
Available P,%	0.42	0.42	0.36	0.33	0.31

[1] Phase 1, 2, 3, 4, and 5 diets were fed from 95 to 135, 135 to 175, 175 to 205, 205 to 230, and 235 to 280 lb BW, respectively.
[2] All dietary phases were fed in both diet forms to each feeder type.
[3] Dried distillers grains with solubles
[4] OptiPhos 2000; Enzyvia LLC, Sheridan, IN.
[5] Paylean; Elanco Animal Health, Greenfield, IN.
[6] NRC. 1998. Nutrient Requirements of Swine. 10th ed. Natl. Acad. Press, Washington, D.C.

Table 2. Effects of diet form and feeder design on finishing pig performance[1]

	Conventional-dry		Wet-dry			P-values		
Item	Meal	Pellet	Meal	Pellet	SEM	Diet	Feeder	Diet × Feeder
d 0 to 91								
ADG, lb	1.86	1.88	1.96	1.99	0.014	0.07	0.01	0.70
ADFI, lb	5.05[a]	5.40[b]	5.51[b]	5.54[b]	0.052	0.01	0.01	0.04
F/G	2.72[a]	2.87[c]	2.81[b,c]	2.77[a,b]	0.033	0.07	0.91	0.01
Feeder coverage score, %[2]	59[a]	90b[c]	74[ab]	78[b]	5.70	0.01	0.79	0.02

[1] A total of 1,290 growing pigs (PIC 1050 × 337, initially 103.1 lb) were used, with 25 to 27 pigs per pen and 11 pens per treatment.

[2] Pictures of feeder pan coverage were taken once during Phase 4. A panel of 4 then scored feeder pan pictures for percentage of pan coverage.

[a,b,c] Means lacking a common superscript within row differ ($P < 0.06$)

Table 3. Effects of diet form and feeder design on carcass characteristics[1]

	Conventional-dry		Wet-dry feeder			P-value		
Item	Meal	Pellet	Meal	Pellet	SEM	Diet	Feeder	Diet × Feeder
HCW, lb	202.3	204.3	207.55	206.9	2.56	0.77	0.09	0.54
Yield, %	75.6	75.3	75.6	76.0	0.003	0.95	0.19	0.24
Backfat depth, in.[2]	0.68	0.68	0.74	0.72	0.02	0.40	0.01	0.57
Loin depth, in.[2]	2.44	2.38	2.35	2.33	0.04	0.39	0.11	0.64
Lean, %[2]	55.8	55.7	54.4	54.6	0.46	0.97	0.01	0.77
Income/pig,$	147.72	148.52	148.87	148.84	1.75	0.80	0.63	0.79
Sort loss[3]	-0.79	-0.99	-1.10	-1.21	0.27	0.49	0.26	0.86

[1] A total of 1,290 growing pigs (PIC 1050 × 337, initially 103.1 lb) were used, with 25 to 27 pigs per pen and 11 pens per treatment. Carcass data were obtained for 939 pigs from 44 pens to determine the effects of diet form and feeder design on carcass characteristics.

[2] Percentage lean, backfat depth, loin depth, and percentage fat-free lean were adjusted to a common HCW.

[3] Sort loss was calculated based upon carcass weight.

Figure 1. Conventional dry feeder with meal diets averaged 59% feeder pan coverage.

Figure 2. Conventional dry feeder with pelleted diets averaged 90% feeder pan coverage.

Figure 3. Wet-dry feeders with meal diets averaged 74% feeder pan coverage.

Figure 4. Wet-dry feeder with pelleted diets averaged 78% feeder pan coverage.